BELLCOMM, INC.
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B70 03015

SUBJECT: Workshop Computer Interface Unit Reliability - Case 620

DATE: March 6, 1970

FROM: R. J. Pauly

MEMORANDUM FOR FILE

INTRODUCTION

The Apollo Telescope Mount Digital Computer System (ATMDC System) consists of two redundant Apollo Telescope Mount Digital Computers (ATMDCs) and a Workshop Computer Interface Unit (WCIU). Triple Modular Redundancy (TMR) is used in critical sections of the WCIU since the ATMDC System is mission critical. The WCIU provides the capability to switch over from the prime ATMDC to the backup ATMDC if the prime ATMDC fails to function properly.

Using TMR circuits enables the WCIU to sustain a single point failure and continue to function properly. As long as two of the three redundant elements of the TMR circuits are working correctly, the proper result will be obtained.

WCIU CHECKOUT

The WCIU undergoes two types of tests prior to a mission. First, the individual elements of the WCIU are tested at the IBM manufacturing facility prior to final packaging. In these tests the proper operation of each of the elements in the WCIU is verified. Second, functional tests are performed during the various stages of acceptance and integration of the WCIU into the Workshop at MSFC, McDonnell Douglas, MSC and the KSC Vehicle Assembly Building. The functional tests verify that the WCIU is working properly as part of the ATMDC System; however, they don't indicate if an individual element has failed, since the WCIU would function properly with two of any three redundant elements working. The individual elements can't be tested after packaging because the test points aren't accessible.

CONCLUDING REMARKS

An undetected single point failure could occur during the six months or more between the individual element tests at the IBM manufacturing facility and the beginning of a mission. If a single point failure exists at launch, a

failure in either of the other two redundant elements would cause the WCIU to fail. Thus the reliability of the WCIU with TMR would be less during the mission than a WCIU without redundant circuits. Since the ATMDC System is mission critical a failure of the WCIU would result in the termination of the mission.

The probability of a single point failure occurring in the TMR circuits during the integration activities prior to the mission must be included in assessing the reliability of the WCIU in performing its functions during the mission. Although the probability of this type of failure occurring may be small, I suggest that the WCIU reliability assessment for the mission be double checked and that consideration be given to providing means of detecting single point failures after integration of the WCIU into the workshop.

Robert J. Pauly

1032-RJP-dmu R. J. Pauly

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